FADCA>BEACON

The FLORIDA AMATEUR DIGITAL COMMUNICATIONS ASSOCIATION Newsletter
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FADCA Nets
3958 Khz. Sundays at 8 AM by K4NTA in Stuart, Fl
147.165 Mhz. Sundays at 7 PM by KF4EF in Brandon, Fl
147.285 Mhz. Sundays at 9 PM by K4AHO in Orlando, Fl

FADCA MEMBERSHIP

Please check your mailing label. If you have a (M) by your name, you are a paid up member; if there is a (C) you are receiving a complimentary copy. Complimentary copies are for organizations and people around the country involved in digital communications who should be aware of our activities. These people also keep us up to date on what is going on in the rest of the country. If there is nothing by your name, you will not be receiving any more issues of the FADCA>BEACON unless you have an interest in what we are doing and care to join by sending in $10. In order to keep this newsletter going, we must cut the mailing down to members only and a small comlimentary list. We use computers just like banks and companies that send you bills. Our computer may have made an error and think that you are not a member and in fact you have paid up. If this is the case, we are sorry. Drop a line to Ted Huf K4NTA, let him know about it and he will dig into the records and find out how the computer screwed up.

A DIGIPEATER - IS IT A REPEATER?

TED HUF, K4NTA
1829 N.W. Pinetree Way, Stuart, Fl. 33494

This question was raised recently because we were looking for a new frequency for SOUTHNET, the FADCA Packet Radio network. The question was asked of the Federal Communications Commission and the answer, though not simple was understandable.

The information is according to John Borkowski of the FCC Private Radio Branch and should be concidered only a verbal reply. That means that it is not necessarily the "official" final word on the subject because it was not in writing. Mr Borkowksi said that as packet radio activity grows it may require special rule making, but until that time we must work under the existing rules.

Part 97.3 defines repeater operation as "Radio communications, other than auxiliary operation, for retransmitting automatically the radio signals of other amateur radio stations." A packet radio station being used as a digipeater would surely fall under this definition. Operations between to stations not using a digipeater would not fall under the repeater definition. Mr Borkowski said that it was the position of the Private Radio Branch that we could call our operation either repeater operation or regular amateur radio communications. It was completely up to us but, he went on to point out the advantages and disadvantages of both.

If we call our operation non-repeater then we may operate on a any part of the band but, in order to digipeat, another stations signals, a control operator must be on duty at the digipeater or it must be controlled by an auxiliary link. This would make the operation of remote site digipeaters impracticable.

If we call it repeater operation, we can not use frequencies where repeaters are not permitted. In the 2-meter band these are 144.0 - 144.5 and 145.5 - 146.0. Also a station that serves as a digipeater must comply with all of the repeater rules in part 97.85, and this could be every station who operates packet radio. While there are some disadvantages to being a repeater, I think that the advantages out weight them. If a station is used as a digipeater and the control operator is not on duty, under the repeater rules it would fall under 97.85(e); automatic control. Our Terminal Node Controllers have a timeout timer for the transmitter and as we know, have a carrier detect to hold off the transmitter if another station in on the frequency. Automatic control would allow us

to operate remote unmanned digipeaters and home stations could be left on while the operator was away.

There are other repeaters rules that must be followed. One is station identification; Part 97.85(d)(1) requires that a repeater be identified with a /R after the station call letters. This will be no problem for the Tucson TNC, just set your IDTEXT to your station call letters with the /R (K4NTA/R). Another repeater rule is Part 97.85(g) that says that if the effective radiated power is greater than 100 watts between 29.5 and 420 MHz. or 400 watts between 420 and 1215 MHz. certain information must be kept in the station records (log book). Below is the required information:

(1) The location of the station transmitting antenna marked upon a topographic map having contour intervals and having a scale of 1:250,000. These maps can be ordered from the U.S. Geological Survey, Washington D.C. 20242 or from many book stores and office supplies;

(2) The transmitting antenna height about average terrain;

The effective height of the transmitting antenna shall be the height of the antenna's center of radiation above "average terrain." For this purpose "effective height" shall be established as follows:

(a) On a U. S. Geological Survey Map having a scale of 1:250000, lay out eight evenly spaced radials, extending from the transmitter site to a distance of ten miles and beginning at (0, 45, 90, 135, 180, 225, 270, 315 degrees). If perferred, maps of greater scale may be used.

(b) By reference to the map contour lines, establish the ground elevation above mean sea level (AMSL) at 2, 4, 6, 8, and 10 miles from the antenna structure along each radial. If no elevation figure or contour line exists for any particular point, the nearest contour line elevation shall be employed.

(c) Calculate the arithmetic average of these 40 points of elevation (5 points of each of 8 radials).

(d) The height above average terrian of the antenna is thus the height AMSL of the antenna's center of radiation, minus the height of average terrain as calculated above.

(3) The effective radiated power in the horizontal plane for the main lobe of antenna pattern, calculated for the maximum transmitter output power which occurs during operation;

(4) The maximum transmitter output power which occurs during operation;

(5) The loss in the transmission line between the transmitter and the antenna (including devices such as duplexers, cavities or circulator), expressed in decibels; and

(6) The relative gain in the horizontal plane of the transmitting antenna.

All of this may sound like a big deal, but, it really is not. If you need any help, let me know.

After my discussions with Mr. Borkowski and after looking over the rules, I feel that repeater operaton is the way to go. This does not say that every station need be classified a repeater and a station can be a repeater only part of the time. If you turn the "DIGIPEAT" command on your TAPR TNC "OFF", no one can use your station as a digipeater and you are not in repeater operation. If you have this command "ON", you could be classified a repeater if anyone used your station to digipeat packets. My feeling is that if you have the digipeat command on, you should add the /R to your call in the "IDTEXT" and turn the "CWID" command "ON". This should put you in full compliance with the FCC Rules, if you are running under 100 watts ERP.

I offer this as a footnote to this discussion. The rules on indentification say that a repeater must be identified in radiotelephony or radiotelegraphy with the "repeater" in voice or "/RPT" in radiotelegraphy. We hear most all repeaters using just /R. The rules also state that the manner of identification may be by telegraphy using any code authorized by Part 97.69(b). Now 97.69(b)(3) says that ASCII is is an authorized digital code. It would seem to me that this means that the identification may be in packet code because it is ASCII but, the call letters in the address field of a packet frame can not contain the required /R for a digipeater. This has not been checked with the FCC but, it seems to me that if the data field of a packet frame contained "DE K4NTA/R" that would also satisfy the identification requirement for a digipeater.

NEW FREQUENCY FOR THE STUART DIGIPEATER TED HUF, K4NTA

Many of you know that the packet radio operation on 147.465 has caused some problems for others operating on near by frequencies offset of 15 khz. We have been looking for another frequency for our operation that will not cause people with receivers with poor selectivity these problems. In some areas, these hams have even done a bit of jamming on 147.465. One thing the jamming has proven is that packets will get through the QRM. Since I was the one who selected 147.465, I have taken it opon myself to select a new frequency, at least for the Stuart digipeater K4NTA-1. After reading the March issue of QEX the ARRL Experimenter's Exchange, selection process was made pretty easy. It is reported in QEX that a new digipeater is in operation in Newington, Ct. on 145.010. It also says that 145.010 is used for digipeaters in Lowell, Ma; Warwick, NY; Central, NJ; and Washington, DC. and that others are expected to fill the gaps in Maryland, Delaware and Southern New Jersey in the near future. In the North East and Atlantic areas 145.010 is becoming the standard 2-meter packet radio frequency for EASTNET. On ths West Coast a similar effort is underway called WESTNET. EASTNET and WESTNET, nice names eh? Tell you what, we will call our packet radio network SOUTHNET and operate in on 145.010 as well. Pretty easy selection as I said. Local operating frequencies are optional, but the wide area operation of SOUTHNET is on 145.010 until we have gateway stations and high speed linking between digipeaters which could be some time away.

THE HOMEBREWED FRAME

HOWARD GOLDSTEIN, N2WX
1707 SW Cardinal St, Palm Bay, FL 32907

XEROX Board Going Packet

A plethora of Xerox 820 "Big Boards" (described by W1BEL p. 3, 1984 March FADCA>BEACON) has appeared on the market, mostly as bare boards but at most reasonable prices, for at least the past six months or so. When K4NTA told me about fully populated boards at $53 ($50+3 handling 214-960-3367 Tues-Fri, 9-4 CST) I jumped at it and after the weekend ordered two of them. As I write this article I do not yet have the boards but am eagerly planning for and anticipating their arrival!

The objective is to develop a controller that on its first pass will:

- o - support two AX.25 level 2 (standard) digipeaters simultaneously on different frequencies at baud rates past 19.2K
- o - provide a gateway between the digipeaters at level 2
- o - have a local TNC
- o - allow for shutdown or reconfiguration of itself from authorized users
- o - Watchdog times

The BB has lots of RAM and since the code for level 2 is only a few K long (including buffers), much of it will be available for added features.

The heart of the system is a Zilog Z-8530 Synchronous Communications Controller. The 8530 was chosen because: it can handle the HDLC functions for two channels simultaneously, it can pass a vector to the Z-80 for efficient mode 2 interrupt handling, it runs NRZI and Manchester modulation, and the code for a re-entrant level 2 is already written and in use at N2WX.

The Z-8530 is similar to the Z-8030 described in my 1984 February FADCA>BEACON article except that it is much easier to interface to non Z-Bus devices because it does not require that addresses and data be multiplexed onto its data bus within the same I/O cycle. *RD, *WR, A/*B (channel select), *CE and D/*C (data/control select) are easily generated with usual logic associated with decoding for an I/O transaction.

Besides the Z-8530, the BB will apparently also need at least a modem(s) and a power supply to fulfill its destiny. Experimentation with different modulation techniques and modems is becoming very popular and you achieve great flexibility in being able to swap modems with a pull on a cable, rather than putting it on board.

Ted (K4NTA) and myself have decided to develop this board to its fullest packet potential. When I have the hardware interface and level 2 complete I'll be sending him the code either via packet or on an EPROM through the mail for a thorough shakedown and evaluation, and then implement his suggestions. If you have a Xerox BB and want to participate in the tests, contact Ted or myself. If you don't have a Xerox BB but have another Z-80 whose internal data bus is accessible you might still be able to use this system - stay tuned.

Channel Monitor

How do you know whether W4ABC is around or not? Well without some sort of personal tracking device you can't really, but a background routine at N2WX-0 logs the call, repeaters used, and the time that the last frame from that call was heard. It is available remotely. To view this list, connect with N2WX-0, send a <CR>/LOG<CR> and the log will be sent.

Languages

We need to decide how to present software in the FADCA>BEACON. Should a PDL (a language for describing algorithms) or actual source listing be included? As far as real languages, the most used seem to be Pascal, C, and native assembler. On its own though, prevalance of one language should not exclude other languages as long as the code they generate is fairly swift, and the source, readable. I'd like to hear what you think about this.

A HOMEBREWED PACKET RADIO SYSTEM (PART 2)
HOWARD GOLDSTEIN, N2WX

This is second in a series of columns describing a homebrew packet station implemented on an S-100 system. The first column talked about the system in general terms. This month I will discuss implementation of the AX.25 link control layer at N2WX.

I/O Line control and the Z-8030

The Zilog SCC effects all line control transactions. The code at level 2 is responsible for initializing the chip, passing it commands, and acting on the various statuses returned from it. The hardware was discussed in the February FACDA>BEACON.

The Frame Control Block (FCB)

The FCBs (not to be confused with a file control block) are the means by which status and data are passed between the Z-SCC and and higher layers. The exact format of an FCB can be described in a C structure:

```
struct fcb {
        int flag;
        int frlen;    /*length of frame*/
        char *fradd;  /*pointer to area where frame is stored*/ };

/*  flag is bit-mapped as below:
          7 | 6 | 5 | 4 | 3 | 2 | 1 | 0
          --+---+---+---+---+---+---+--
          L | Z | x | x |x | x | L | Z-- 1 if frame rxd here
          |  |   (don't care)  +------ 1 to xmit this frame
          |  +-------------------------- 1 when frame sent
          +------------------------------ 1 to hold this FCB
     L bits are command bits set by the next higher layer
     Z bits are set by the level 2 code in response to either
     the reception of a valid frame or commands from
     previously set L bits
```

Procedures

The procedures of level 2 may be divided into four areas: Frame receive, Frame transmit, repeater, and ID beacon.

There are actually two entries to the level 2 routines in this version. One is called by the operating system periodically to service the receiver. The other entries are made from a polling function that looks at each FCB to see if transmission of a frame is required. The poller also examines the time of day for the ID beacon and initiates its transmission.

Receive

When the Z-SCCs receiving flags it resets it's *SYNC when the opening flag of a frame is received. When the first character of the frame is received by the chip, the condition is noted by a routine that is called by the operating system every 6ms (slightly shorter than a character time at 1200 baud). This routine trys to find one empty FCB out of the 16 available. If it does it passes the FCB's address to the rx_frame() function which looks up where it is to store the rest of the frame from the address in the FCB and attempts to read more data from the SCC.

At this point, the SCC could do one of three things. It could lag that a received character is ready and/or an end of frame was received, or it could return an abort received status. Received characters are popped off the SCC's three character FIFO and stored in the area marked by the FCB. The end of frame and abort conditions terminate the receive loop, else the routine goes back and waits for another status update from the SCC.

The receive loop passes a value to rx_frame() which is the value of the SCC's RR1 register. The register contains the END OF FRAME and CRC ERROR bits. Bit 0 of the FCB's flag field is set and so is the length field if end of frame is true and crc error is false else it is reset. The repeater routine is called [rpt_lev2()]. Control is returned then to the operating system so that other jobs may proceed.

Transmit

Higher layers indicate the need to transmit a frame by setting bit 1 of an FCB's flag field. The poller function for level 2 notes that this flag is set and it calls tx() and passes the address of the FCB needing to be serviced.

When the channel is free and some timers are satisfied, tx() "presses" the PTT with the SCC's RTS bit and waits for CTS to go true. When the modem is ready the SCC's CRC generator is reset and tx() starts passing the data in the frame to the SCC. After all the data is transferred tx() waits for the transmitter to underrun, which is a signal to the SCC to send the CRC and closing flag and to us. The transmitter can now be shut off (if nothing else needs to be sent), the 'frame sent' bit in the flag field is set, and we do something else.

Repeater

When a frame is correctly received and prior to control being returned to the operating system, the frame is examined to see if it must be repeated. If the global callsign and active SSID are found in the current repeater sub-field, the H bit is set, the receive frame available flag in the FCB is reset and the transmit frame command bit in the FCB is set. Since actual transmission does not occur until the 16 FCBs are polled once more, it's possible to repeat multiple frames.

ID Beacon

Part 97.84(c)(d) contains the requirements for ID of a repeater. Every 9.5 minutes the level 2 polling function recognizes a 9.5 minute interval (by examining (# seconds past hour MOD (9.5 * 60)). If the result in zero, a stock UI frame is moved into an empty FCB and it is flagged for transmission.

Please remember that every TNC that is capable of digipeating MUST identify with "/R" or "/RPT", especially if you leave it unattended. To do otherwise could be courting trouble with uncle Charlie.

The source code is available for non-commercial on disk for a blank floppy and $10 to cover shipping and expenses. The format is Oasis 8" single sided double density.

VIRTUAL TERMINAL HOWARD GOLDSTEIN N2WX

As more and more applications become offered on packet, we may find that it would be easier to live with a standard for CRT device commands than it would with having to implement a potentially large number of terminal classes at each server. A standard might make interfacing screen based applications like word processing and form filling less cumbersome to offer over the air.

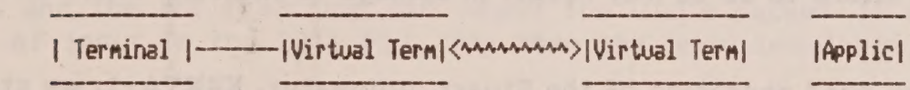
After some thought it became apparent that no matter what command set was choosen, practically everyone would need to write or somehow get a driver to handle the conversions. This just can not be avoided, as your Commodore 64 won't move the cursor on his PC or my TeleVideo without mapping to the appropriate commands.

Initially a choice must be made on whether a moded or non-moded structure will be used. A moded structure would have 1 or 2 escape characters common to all CRT commands. In command sets without modes, a single character is sometimes enough to get the point across which speeds things up a bit.

Even the dumbest terminals and terminal emulators are usually capable of clearing their screens and moving their cursors around (up,down,right,left,and randomly). These basic features are really all that you need for a screen oriented word processor. At 1200 baud it won't be fast but will be usable. Terminals (or software if your display is memory mapped) exist that can erase selective areas of the display, insert and delete lines and characters, and make text blink or come up in reverse video, etc. Should the standard allow for a full set and a standard subset of command for the dumb terminals?

Here are two sample minimum command sets that we could test. Note that one is moded, the other partially moded:

	X3.64 (moded)	TeleVideo TVI 950
Home	ESC,[,H	RS
Clear	ESC,[,H,ESC,[,2,J	ESC,*
Left	ESC,[,D	BS
Right	ESC,[,C	FF (note-non destructive)
Up	ESC,[,A	VT
Down	LF	LF
X,Y	ESC,[,r,;,c,H r and c are absolute row and columns coded in ASCII	ESC,=,r,c r and c are biased by 31 dec (row 1 = 32)



BYTES FROM THE WRITE ONLY MEMORY TED HUF, K4NTA

By the time that you read this, Gwyn W1BEL will have been on overseas duty for about three weeks. We will miss him and his leadership for the four mounths that he will be away. During his absence, we will keep FADCA and the FADCA>BEACON going with your help, hopefully up to the the high standards that Gwyn has set.

It you want to drop Gwyn a line his address is:

Lt. Col. Milton G. Reedy
USCENTCOM FHE Staff
USS LaSalle (AGF-3)
FPO New York 09501

I have been asked by non-packeteers "what do you do with packet radio, just type like on RTTY?" Well the answer is NO. To show just what can be done, the other night, Jim WD0EEL in Boca Raton asked if I could send him the listing of the BBS program that I use on my TRS-80 III. He wanted to take a look at it to see how files were handled so he could write one for his IBM. I converted the main BBS program to an ASCII text file. When Jim and I connected via the Stuart Digipeater (K4NTA-1), he opened a disk file and I sent the whole file to him. All 22,000+ bytes were sent in about 10 minutes. At the same time I was sending the file, Tom K4GFG in Davie and Howie N2WX in Palm Bay were in QSO via the same Stuart Digipeater. Howie told me later that he heard all the activity on the frequency, but that it did not seem to slow down his thoughput to Tom at all. This really points out the way that packet radio conserves spectrum. Can you imagine doing that using RTTY even with ASCII at 300 baud? If could have sent in about the same amount of time, but not error free with another QSO on the same frequency.

This issue of the FADCA>BEACON was published with the aid of packet radio. The articles by N2WX were sent to me via radio. I saved them in a disk file and then ran them though my word processor for printing. We soon will have the FADCA membership list on the Stuart FADCA BBS (K4NTA) for down loading. Nancy, WD4BRG and Guy, KA4VWW are working on this.

The Palm Beach A.R.E.S. Group which operates the 146.67 repeater in West Palm Beach has purchased a TAPR Kit TNC and will be putting it up as a digipeater at the same site as the 146.67 repeater. Operation will be on the SOUTHNET frequency of 145.010. If any of your local clubs and repeater groups would follow the forward thinking of the Palm Beach A.R.E.C Group, we would have the State of Florida linked in no time. There is not even anyone on packet yet in West Palm Beach! What a way to get the interest of their club members. A big thanks goes out to the Palm Beach A.R.E.S.

We have many out of state readers fo the FADCA>BEACON. This is to give these people, who might not be familiar with Florida an idea of our present converage. The Stuart digipeater, K4NTA-1 is running 55 watts with the antenna at 300 feet. Palm Bay is 55 miles north, Ft. Lauderdale is 70 miles south. The Brandon/Tampa area is 130 miles West North West and Orlando is 125 miles Northwest. When 2-meter conditions are good, the Stuart digipeater can tie all of these cities together. Now I am not saying that it can be done every day, but with a few more digipeaters it could be every day. The group in Brandon/Tampa is going to put a digipeater up at around 300 feet in Brandon. What we need is someone in the various areas to contact the local clubs about sponsorship and support and to be willing to maintain the equipment. The radio need not cost much. An old commerical radio or crystal controlled 2-meter rig works fine. No duplexers are needed, but you do need a TNC.

A word of caution! If you try to remove the 1488 and 1489 chips to use TTL levels rather that the +/-12 RS-232 levels normally required by the TAPR TNC board be very careful. You should use some form of buffering. Failure to do so may result in damage to the TNC UART or the computer to which you are connecting.

After two weeks of very good operation of the Stuart digipeater, K4NTA-1, we started to notice that it seemed to be somewhat deaf. I thought for sure that the brand new GaFET preamp had died. I am glad to report that the preamp lives, but there is another problem. Investigation showed that we have power line noise. A ride out of the area around the tower site turned up the pole(s) causing the noise. It was about 1/4 mile from the tower on US1. I called a the power company and it was cleared up by 6:00 PM that night. Great work by Florida Power & Light and their best radio man WB4EPK from Jupiter.

Bill Sams, KF4LG and Pat Shaughnessy, KF4EF will be conducting a packet radio demo in New Port Richey on April 23rd. Bill tells me that he could use some help from you fellows in the area. Give Bill or Pat a call if you can help out.

While Gwyn is away, please send membership applications, questions and news idems for this newsletter to me. Other mail can still go to Gwyn at the Brandon address it will be forwarded to him or me. Speaking of news idems for this newsletter, sure could use some. My creative juices run out pretty quick so come on and let's hear from you about what is going on with your operation. I will try to go to press with the May issue about May 1st so please try to get anything for the newsletter to me by then. It would also help if I knew that you were sending something.

XR2211 MODIFICATIONS TED HUF, K4NTA

In the February issue of the FADCA>BEACON there was an article by KV7B and W0RPK on modificatons to the TAPR Beta and Kit TNC's. I made these mods in two Beta TNC's and found good results. The mod is rather simple and I would recommend it to anyone using the TAPR gear who thinks that his board may not hear well. The how to stuff is covered very will in the February FADCA>BEACON so I will not go over it again. If you need the information, let me know. I did a little test to find out just what if any improvement I had made. I connected a step attenuator in the antenna line of my Icom IC-22A. Of course I unplugged the mic first. Then before any modifications were made, I asked Geogre WD4BRF to send me the default beacon every 10 seconds. I then switched in attenuation until I got about 50% copy based on an average of about 24 packets. Then the modification was made and more attenuation was added until I got the same 50% copy. On one board I gained 4 dB and on the other about 2 dB. Adjustment of the XR2211 center frequency was the most difficult part of the job. On the Beta boards the 1700 Hz. calibration routine does not work very well. I used the procedures outlined in the January 1984 Packet Status Register which goes like this. First remove jumper 5 and set jumper 4. Next short pins 2 and 10 on the XR2211 (U18) together. Be careful and don't short out anything else. Connect a frequency counter to the mic audio line at pin 5 of J3 or to the pin of jumper 8 that is nearest the edge of the board. Adjust the top pot (R16) for a reading of 1685 Hz. Even with this procedure, the counter reading was not too steady on one of the boards. It seems to require a very sensitive counter. The calibration routines do not have to be used to make this [illegible]stment but, [illegible] may want to enter step 6 on the calibration routine to be sure that all t[illegible]mpers are b[illegible] the correct place.

TNC AF LEVEL ADJUSTMENT

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The article Deviation Adjustment For Packet Operation by Gary Field, WA1GRC in the March, 1984 FADCA>BEACON parallels the same method I used to adjust my TNC audio output to the transmitter. Later experiments seem to point out the TNC AF output is more critical than anyone realized and the by-ear method is not adequate. In fact an oscilloscope is necessary to set the level properly, but more on that later.

The TNC transmitter AF level adjustment does have an effect on the ability of the RX'ing TNC to copy less than perfect signals. In the TAPR manual and in the TAPR Packet Status Register it is stated that a problem exist with the modem's 2211 chip when the two tones (1200 and 2200) are more than 3 dB out of amplitude balance. EXAR explains that when the tones of the a PLL detector (such as our 2211) are out of amplitude balance the PLL takes longer to lock up and pass data. When each pulse at 1200 baud is only 2 cycles long at 2200 hz. and delay in lock up will effect the data output, and the WE 1933 chip will reject the whole packet. If and oscilloscope is used to monitor the AF input to the 2211 PLL chip then the level imbalance can be observed firsthand.

There are three factors that effect the amplitude balance the 2211 PLL chip sees. The first is the IDC (instantaneous deviation control) which is dynamic and may compress the higher tone more that the lower. The second is the pre and de-emphasis of the transmitter and the receiver which is passive. The third is the MF-10 active filter on the TNC board. I could go into a long discussion on how each effect the balance but I don't think it is really necessary. The emphasis and the MF-10 circuits hopefully are reasonably uniform from rig to rig and TNC to TNC. The IDC being the dynamic circuit does vary from transmitter to transmitter. The difference probably cannot be discerned by ear, requiring an oscilloscope for proper adjustment.

I believe the proper method of TNC AF output adjustment can be done very similar to Gary's method. I would add two extra steps. Feed the extra receiver audio back into the TNC input, and monitor the 2211 PLL input with an oscilloscope. Adjust the TNC transmitter output audio for best amplitude balance at the 2211 PLL chip. You can also observe how will everyone else is set up at the same time.

The ultimate solution to the tone balance problem may be two tone detectors using the 2211 PLL chips but that is a story for another day.

TAPR MODEM NOTES

Tom Kneisel K4GFG
1600 WS 115th Ave, Davie, FL 33325

In the few weeks since I've had my new TAPR kit, I've been looking at the radio side of it and wondering how to get the best performance out of the RF channel. Here are some observations that may be of interest to you.

First, the receiver audio section has a bandpass response as shown in fig. 1. Between 1200 and 2200 Hz, the slope is about 8 dB per octave, which results in an amplification of the 2200 Hz tone about 7.5 dB above the 1200 Hz tone (if they were to be input to the board at equal levels). I then measured a commerical hand-held portable radio, the Mototola MX350. It's receiver audio response is shown in fig. 2. This de-emphasis rolls off the received audio at 2200 Hz by about 6.5 dB relative to the 1200 Hz tone.

We find then that the receiver plus the TNC board together appear to form a fairly flat response combination, with the TNC board compensating for the receiver rolloff to within about 1 dB. Lyle Johnson of TAPR has written that the Exar 2211 demodulator chip is very sensitive to amplitude imbalance of greater than 3 dB, and that a 6 dB imbalance will render the channel inoperative. (1) If true, this would seem to require that the tones be transmitted with nearly equal deviation by the transmitter. A good way to do this with minimal phase distortion would be to bypass the transmitter audio circuits altogether. This is not always practical, and Gary Field has suggested how to best adjust transmitter audio circuits for drive level and deviation. (2) (But will that result in a flat transmitter audio response? Also see Jim Diggs' discussion in this issue; Editor)

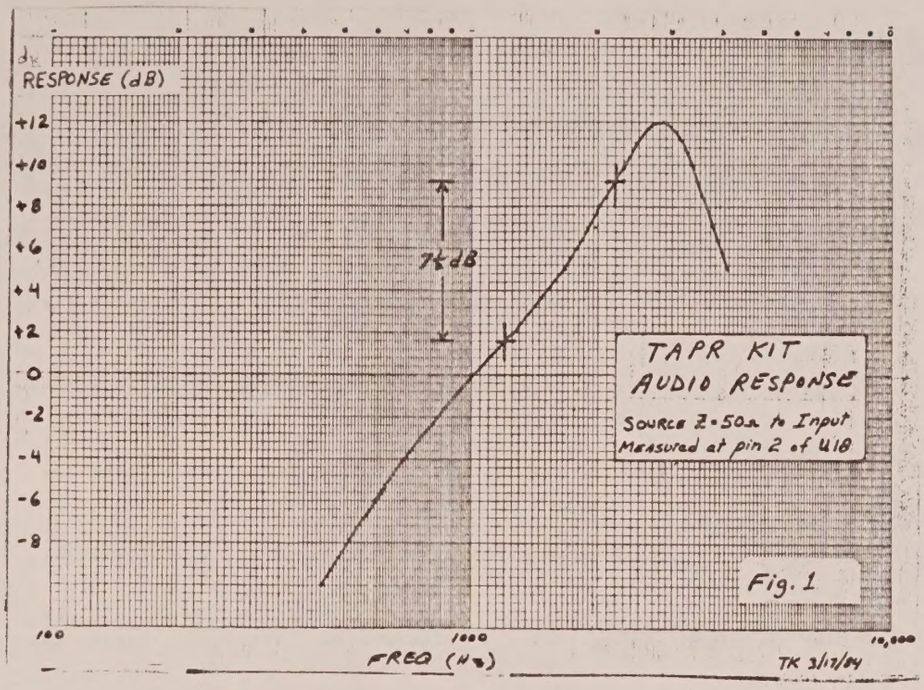
I then measured my 2m transceiver and found that my Yaesu FT 221 receiver has a de-emphasis of only 2 dB between 1200 Hz and 2200 Hz! Using the speaker output did work, but not well on weak signals. I decided to bypass all the audio shaping in the Yeasu and to pick the receiver signal off the discriminator. What I then needed was a flat response filter for my TAPR TNC! Fortunaltely TAPR's Dan and Margaret Morrison have detailed the changes to the TNC filter header U30 that result in a flat response with linear phase. (3)

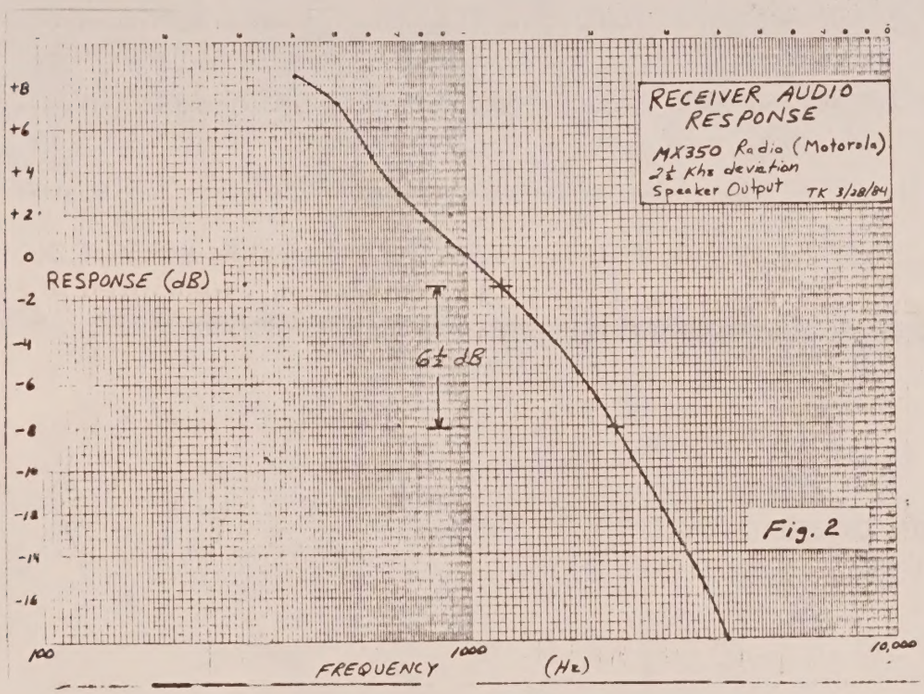
To test how well this works, I took the (no-signal) noise out of my receiver's discriminator, summed in the TNC's transmit audio tones, and fed this audio to the TNC receive input. Putting the TNC in the fill duplex mode and transmitting packets of a single text character, I found the results shown in fig. 3. PPR is the packet probability of reception, as described in Steve Goode's article in QEX. (4) The curves also show that the modifications recommended in February's FADCA>BEACON (5) yield about 2 dB improvement. In general the board has good S/N performance. These tests were done with audio tones in noise which is presumably parabolic in spectral shape (more noise at higher frequencies). How does this test relate to actual on-the-air preformance where the noise characteristics may be different?

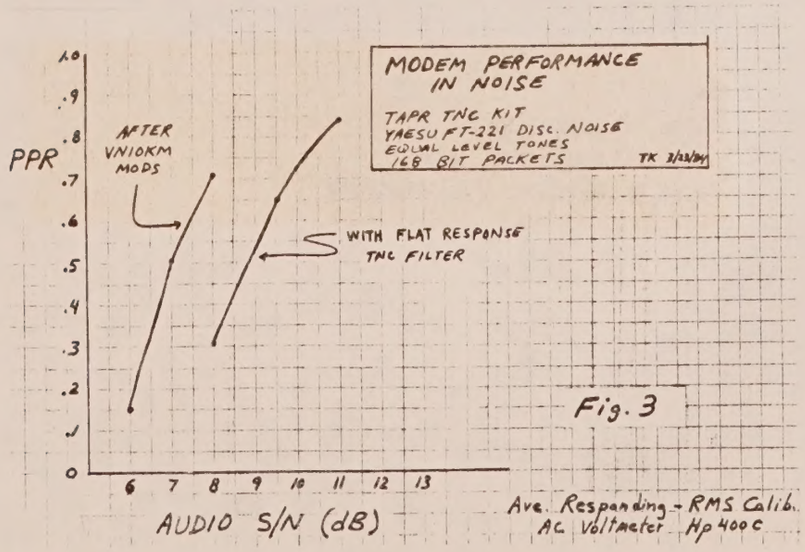
That is a more complicated study with numerous variables. Initial results seem to indicate that as the signal level is lowered, the PPR is degraded sharply just at the onset of the well known "clicks" in the audio output. Just above this threshold point the audio S/N ratio should be fairly high (about 20 dB for 3 Khz deviation). Therefore we adequate and will have little effect upon receiver sensitivity if the clicks are what destroys the PPR. It is also knows that the click rate (or onset of the clicks) is worse with increased deviation. These issues and others must be investigated, and I hope to have some results next month.

References

1. Johnson, Lyle. "Unique Features of the TAPR TNC". Second ARRL Amateur Radio Computer Networking Conference Proceedings, March 19, 1983. ARRL, Newington, CT.
2. Field, Gary. "Deviation Adjustment for Packet Operation". Reprinted in FADCA>BEACON, March 1984. Florida Amateur Packet Radio Communications Asso., Brandon, FL.
3. Morrison, Dan, Margaret Morrison. "HF Packets". Packet Status Register, Jan. 1984. Tucson Amateur Packet Radio Corp.
4. Goode, Steve. "BER performance of the TAPR TNC Modem". QEX, August 1983. ARRL, Newington, CT.
5. Morrison, Dan. "New Modem Details for the TAPR TNC". Reprinted in FADCA>BEACON, Feb. 1984. Florida Amateur Digital Communications Asso. Brandon, FL.


RESPONSE (dB)
+12
+10
+8
+6
+4
+2
0
-2
-4
-6
-8
7±dB
TAPR KIT
AUDIO RESPONSE
Source Z=50Ω to Input
Measured at pin 2 of U18
Fig. 1
100
1000
10,000
FREQ (Hz)
TK 3/17/84


RECEIVER AUDIO
RESPONSE
MX350 Radio (Motorola)
2± Khz deviation
Speaker Output TK 3/28/84
+8
+6
+4
+2
0
-2
-4
-6
-8
-10
-12
-14
-16
RESPONSE (dB)
6± dB
Fig. 2
100
1000
10,000
FREQUENCY (Hz)


MODEM PERFORMANCE
IN NOISE
TAPR TNC KIT
YAESU FT-221 DISC. NOISE
EQUAL LEVEL TONES
168 BIT PACKETS TK 3/27/84
PPR
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
AFTER
VNIOKM
MODS
WITH FLAT RESPONSE
TNC FILTER
Fig. 3
6 7 8 9 10 11 12 13
AUDIO S/N (dB)
Ave. Responding - RMS Calib.
AC Voltmeter Hp 400C

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